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mergence of some 450 feet. The supposed glacial drift about Birmingham and the concentration of boulders at Wolverhampton were regarded as due to the former agent, while the deposits at Cromer and the distribution of Lincolnshire chalk across Southern England was due to the latter. The supposed esker at Hunstanton was held to be simply a sea-beach, and the London drift deposits to be of aqueous origin. Thus the rival theories of floating icebergs and of land glaciers were both true, the one for Middle and Southern England, the other for Scotland, Wales and the north of England; and the line of demarkation was fixed by great terminal moraines.

The paper closed with an acknowledgment of indebtedness to the many geologists of England and Ireland who had uniformly rendered most generous assistance during the above investigation.

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SOME PECULIARITIES OF THE LOCAL DRIFT OF THE ROCKY MOUNTAINS.¹

BY DR. THEO. B. COMSTOCK.

ALL authorities upon the subject of the glacial deposits of the Rocky Mountain region agree in describing them as local or much restricted in extent. Some writers dismiss the matter with this remark, leaving it to be inferred that in other respects the character of the drift is quite similar to the well-known *débris* of the Eastern United States. Others have been more explicit and have shown how special conditions of topography have affected the accumulations in certain localities. In all cases where the details have been given the evidence is strong of excessive erosion, but almost invariably the transportative effects have been remarkably slight. As a natural result we meet with much variety in the gulches and gorges which can be traced to such an origin, while the diluvium of the subsequent melting period is made up of homogeneous materials in each instance, but wholly of local detritus. This gives to many of the unmodified morainal deposits a resemblance to alluvium which is quite striking. On the other hand, in some places (as notably near the head of Wind river, Wyoming) iceberg deposits are well simulated by the collections of boulders which have evidently rolled down the steep

¹ Paper read before the A. A. A. S., Section E, Buffalo, 1886.

slopes left in side-gulches by the retreat of the diminutive glaciers. Existing glaciers in the Wind River mountains and in the San Juan mountains (S. W. Colorado), enable us to witness the actual production of some of these peculiar effects and to understand more clearly how *defragation*¹ has played a very important part in the rough chiseling of mountain features in the far West.

The general southward trend of the glacier-cut cañons is very marked, although numerous side-gulches follow more or less transverse courses. In Northern Wyoming, at the close of the Glacial Period, the old Tertiary lake basins were still in condition to receive and assort the material deposited by the melting ice, and the greater part of the drainage was easy; but in some cases in the interior of the mountain masses to the northward, narrow, elongated basins were ploughed out below the general drainage, although very few of these now exist in which an outlet has not since been made. In the heart of the Wind River mountains a remarkable structure of this kind is to be seen nearly opposite old Camp Brown, at the head of the North fork of the Popo-agie river, near the base of Fremont's peak. Here two of these deep, narrow cañons run parallelwise for several miles, with small glaciers still acting upon their shaded sides, the drainage from one being to the Missouri tributaries, the other feeding affluents of the Colorado drainage. In Southern Colorado somewhat similar features are apparent, but the excessive folding and faulting of the strata have very much complicated matters, so that the results are rather unique. The same type, modified by lithological and structural conditions, may be observed in the Gunnison region and about the sources of the Snake and Yellowstone rivers in Wyoming, but the special San Juan features are not repeated exactly in any other district so far as my observation goes. The distinctive peculiarity lies in the duplex character of the erosion; that is to say, there are two zones of glaciation vertically, the upper largely representing the transportative action, the lower being eroded without removal of the *débris* to any great extent. The imperfect drainage had fastened the ice-sheet so that it could move as a unit only in the superficial portion, while the lower part acted like a slowly work-

¹ I propose this term to express the breaking or tearing down of masses of rock from the walls of gorges, as distinguished from the ordinary abrading or grinding action of the glacier.

ing plough, which cut deeply but not so extensively as the over-riding mass. In the more elevated tracts, therefore, the lower portion often lay in grooves like *culs-de-sac*, and many of these exist to-day, connected with the main channels often by reversed or indirect drainage. The *lower limit of exportation*, which defines the line of junction of the two layers, follows nearly the contour of 11,000 feet above sea-level (varying from 10,500 feet to 11,500 feet). The side-gulches, except where eroded by more recent aqueous action, commonly join the main cañons on this grade. The "timber-line" is fairly continuous with these *debouchures*, and I am satisfied that this feature has been largely instrumental in determining that sharp line of demarkation. Undoubtedly the melting of the ice in the cañons left many side-glaciers discharging by "ice-falls" over the walls for a long time afterwards, the vegetation growing up to this limit, because the land-locked cañons were for a period filled with water which arranged more or less of soil along the sides of the channels. This fact is clearly proven by the occurrence of terraces, in such lacustrine material, up to a height of 1000 feet above the present stream beds in places. The positions of scattered boulders in the cañons, and of those imbedded in the deposits along the walls afford further evidence of the local transportation of material by floating masses of ice, which dropped their burdens upon melting.

The drift of the Rocky mountains thus possesses peculiar interest, corroborating the notion of its intimate relation to the glacial deposits of the east, and yet exhibiting a variety in detail which may aid materially in unraveling obscure points in the history of other areas with weak development of the same conditions. The local character of the effects has prevented many from appreciating the really gigantic erosion and deposition which have taken place.

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THE MAMMARY GLAND OF THE ELEPHANT.

BY SPENCER TROTTER, M.D.

IN studying any particular animal form we are wont to refer to some other well-known type as a basis for comparison, and in this way gain an idea of the animal's place in life, its relations to the environment and to the other beings among which it lives. As our studies extend and we become more widely acquainted with